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Canada. Atomic Energy. Special
Committee on the operations of the
Government in the field, at, 1952/53

(HOUSE OF COMMONS

Seventh Session—Twenty-first Parliament
1952-53

(SPECIAL COMMITTEE

on the

Operations of the Government

in the field of

ATOMIC ENERGY

Chairman: G. J. McILRAITH, Esq.

MINUTES OF PROCEEDINGS AND EVIDENCE

No. 3

[and
reports]

WEDNESDAY, MARCH 25, 1953

including

Chairman's Summary of Chalk River Visit on March 13-14.

WITNESS:

Mr. William J. Bennett, President and Managing Director, Eldorado
Mining and Refining Limited, and President, Northern Transportation
Company Limited.

EDMOND CLOUTIER, C.M.G., O.A., D.S.P.
QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
OTTAWA, 1953

APR 2 1953
UNIVERSITY OF TORONTO



ERRATA

Evidence No. 1, March 4, 1953

Page 15: In the sixth last line, delete "1,000" and substitute "1,600". In the fifth last line, delete "2,000" and substitute "24,000".

Evidence No. 2, March 9, 1953

Page 24: In line 33, delete "245" and substitute "235". In the sixth last line, delete "implement" and substitute "supplement".

Page 35: In the thirteenth last line, delete "peter" and substitute "level".

Page 39: Delete the fifth paragraph beginning with "Dr. Gordon:" and add to the fourth paragraph the following words: "Take Dr. Gordon: I do not know how you identify him with any part of the country. I do not know what part of the country we identify Mr. Scully with."

MINUTES OF PROCEEDINGS

WEDNESDAY, March 25, 1953.

The Special Committee appointed to examine into the operations of the Government in the field of Atomic Energy met at 10.00 a.m. The Chairman, Mr. G. J. McIlraith, presided.

Members present: Messrs. Brooks, Coldwell, Gibson, Green, Kirk (*Digby-Yarmouth*), McCusker, McIlraith, Murphy, Murray (*Oxford*), Pinard, Stuart (*Charlotte*), and Winkler.—(12).

In attendance: W. J. Bennett, Esq., O.B.E., B.A., President and Managing Director, Eldorado Mining and Refining Limited, and President, Northern Transportation Company Limited.

The Chairman tabled a list of corrections for the record (See *Errata*).

Mr. McIlraith informed the Committee he was supplying to the Clerk of the Committee his summary of the visit to Chalk River on March 13, and 14, for incorporation into the record, which is as follows:

Members present: Messrs. Brooks, Coldwell, Gibson, Green, Kirk (*Digby-Yarmouth*), McCusker, McIlraith, Murphy, Murray (*Oxford*), and Stuart (*Charlotte*).—(10).

On March 13, the above members of the Committee made an inspection tour of the plant and, following introductory remarks by Dr. C. J. Mackenzie, heard classified evidence given "off the record" by the following officials:

Dr. David A. Keys, Chairman of the Co-ordinating Committee, Atomic Energy of Canada Limited;

Dr. A. J. Cipriani, Director of the Biology and Radiation Hazards Control Division;

Dr. R. M. Taylor, Director of the Medical Division;

Dr. L. G. Cook, Assistant Director and Head of the Chemistry Research Branch;

Dr. W. B. Lewis, Vice-President in Charge of Research and Development; and

Dr. C. J. Mackenzie, President, Atomic Energy Control Board, and Atomic Energy of Canada Limited.

On March 14, an inspection of the village of Deep River was made.

Mr. Bennett was called and read into the record briefs on the history and operations of Eldorado Mining and Refining Limited and of Northern Transportation Company Limited.

At the conclusion of Mr. Bennett's evidence, it was agreed to reserve questioning thereon until the next meeting of the Committee.

At 11.30 a.m. the Committee adjourned until 10.00 a.m., Monday, March 30.

A. SMALL,
Clerk of the Committee.

EVIDENCE

MARCH 25, 1953.

10.00 a.m.

The CHAIRMAN: I see a quorum. There are some errata which I want to put on the record. They are very short and non-technical.

(See Errata).

I propose to put in a short summary of the meeting at Chalk River, just a summary of the fact that there was a trip there. I presume that will be agreeable.

Mr. MURPHY: The gentleman who spoke in the afternoon was?

The CHAIRMAN: Dr. Cook.

Mr. MURPHY: I suppose he had a prepared speech. Could you make that available?

The CHAIRMAN: I shall check that, and if it is in a form capable of being published, we will distribute it.

Mr. MURPHY: I think he said that he had some extra copies. I thought we would like to have it because we have his former speech.

The CHAIRMAN: I shall check that.

This morning, we have with us Mr. W. J. Bennett, President and Managing Director of Eldorado Mining and Refining Limited. I asked Mr. Bennett to prepare a brief dealing with the Eldorado operations. If it is your wish, I shall now ask Mr. Bennett to speak.

Mr. W. J. Bennett, President and Managing Director, Eldorado Mining and Refining Limited, Ottawa, called:

Mr. MURPHY: Have you got copies of your brief?

The WITNESS: I can get copies for you later in the day. I have been operating on a rather tight time-table and I did not get my brief into final shape until late yesterday. My secretary did not have enough time to make copies.

Mr. MURPHY: We can get our *Hansard* copy about as soon as we could get them.

The WITNESS: Yes. We could get out copies for you, but it would take the rest of the day.

Mr. MURPHY: That will be all right.

The CHAIRMAN: Mr. Bennett.

The WITNESS: Since this is the first occasion on which I have had the privilege of appearing before your committee, I have thought that it might be helpful if I were to tell you something of the History of Eldorado Mining and Refining Limited, its Organization and Current Activities, its Financial Affairs, and its Purchasing Policy. While these subjects are interrelated, I think it may be useful to an understanding of our work if I discuss them under separate headings.

History

The present company, Eldorado Mining and Refining Limited, is the successor to Eldorado Gold Mines Limited. The latter company was incorporated in 1926 for the development of a gold property in the province of

Manitoba. This property was closed in 1929. The surplus funds then in the company's treasury were used to carry out an exploration program in the North-west Territories. The result is now a part of the mining history of Canada. Pitchblende was discovered in May 1930 on the southeast shore of Great Bear lake at a point now known as Port Radium. Mining at Port Radium began in 1932. In 1933 a plant was built at Port Hope, Ontario, to refine the concentrates produced at the mine.

I think it important to note that the company's principal product in the years prior to the war was radium for use in therapy and in luminous compounds. There was some production of uranium for the ceramic industry, but this was of little consequence. Before the discovery of the Great Bear lake deposit, the Belgian Congo was the major source of radium. The Congo is still the most important single source of both uranium and radium, although there is now every indication that production elsewhere will equal and perhaps surpass that of the Congo. Radium produced from the new source in Canada, both because of the location of the property and because of the difference in the grade of the ore, was never seriously competitive with radium produced in the Congo. However, the entrance to the field of a new producer did have the effect of destroying a monopoly position with the expected result—reduced prices. This reduction, while undoubtedly beneficial to mankind, was not particularly helpful to the treasury of Eldorado. The company at no time earned a dividend during the years when radium was its principal product.

With the dislocation of markets which followed the invasion of western Europe by Germany in 1940, it was decided to close the mine at Port Radium, and to confine the company's activities to the sale of radium then in inventory.

The rest of Eldorado story is a part of that remarkable achievement, the atomic bomb. We are told in the fourth volume of Mr. Churchill's memoirs of his meeting with President Roosevelt at Hyde Park in June of 1942 and the decision which emerged from that meeting that the United States would embark on this vast, costly, and highly speculative undertaking. The work was entrusted to the United States army engineers and given the name of the Manhattan Project. Canada was a partner in this enterprise from its inception. Our possession of the most readily available source of uranium and of the only plant on this continent capable of refining uranium would have brought this about, apart from other considerations. In 1942, Eldorado Gold Mines Limited was given a contract to produce uranium for the Manhattan Project. The mine was re-opened in the summer of 1942 and production began in August of that year. Before concentrates from Port Radium were available for refining, The Eldorado Refinery at Port Hope accepted a contract for the refining of uranium from the first shipment of Belgian concentrates to reach this continent. In July 1943, the name of the company was changed to Eldorado Mining and Refining Limited, since the old name was hardly descriptive of the company's new activities. The new company, like its predecessor, had a provincial charter. On January 28, 1944, the Government of Canada expropriated the shares of Eldorado Mining and Refining Limited. Some months later application was made for Dominion charter. The new company was given the name of Eldorado Mining and Refining (1944) Limited. During the past year, the "1944" has been eliminated from the company's title.

Throughout the war years, the company continued to supply uranium to the Manhattan Project. With the end of the war, there was some reason to believe that the atomic weapon program would be reduced in line with the then prevailing policy of the United States government of cutting back arms production. As it happened, the program was expanded. I do not pretend to know all the reasons for the adoption of a policy which on surface, at least, appeared to run counter to the common policy. Possibly the most important

single factor was the complete failure of the western nations to reach agreement with the U.S.S.R. and her satellites as to the future control of fissionable materials and atomic weapons. In this connection, you will recall the Baruch proposals and the protracted and acrimonious discussions which followed their submission to the United Nations in 1946. In any event, it is sufficient for our purposes that the decision of the United States government was a most prudent one, having in mind subsequent international developments. The Government of Canada in its turn decided that the wartime partnership should be continued. In terms of raw materials, this meant that we would not only continue to supply uranium to the United States Atomic Energy Commission, the successor to the Manhattan Project, from our existing sources, but that we would make a vigorous attempt to find new sources. This brings me to my second heading.

Organization and Current Activities

At the time of the expropriation of the company's shares, there was no disturbance of management or change in operating practice, and to this day the company has continued to operate as does any other mining company. Its shares are held in trust for Her Majesty by the Minister of Defence Production to whom its board of directors reports.

The directors of the company are:

Dr. W. F. James, Consulting Geologist, Toronto.

R. T. Birks, Q.C., Barrister & Solicitor, Briggs, Frost, Birks & Langdon, Toronto, President of Consolidated Howey Gold Mines Ltd., and East Malartic Gold Mines Ltd.

Eldon L. Brown, B.A.Sc., Mining Engineer, President and Managing Director, Sherritt Gordon Mines Ltd., Toronto.

J. A. MacAulay, Q.C., Barrister & Solicitor, Aikins, MacAulay, Thompson & Hinch, Winnipeg.

Fraser D. Reid, B.Sc., L.L.D., Consulting Engineer, Toronto.

C. G. Williams, Mining Engineer, formerly Professor Mining, University of Toronto.

W. J. Bennett, President and Managing Director, Eldorado Mining & Refining Ltd., Ottawa.

It will be noted that all of these directors, with one exception, are either by profession or association, in close touch with the mining industry.

The head office of the company is located in Ottawa. The head office organization comprises the president and managing director, the treasurer, the secretary, and their respective staffs.

I said a moment ago that the company operates as does any other mining company. This being so, its organization is similar to that of other mining companies. It has three principal divisions—exploration, mining, and refining, which I shall discuss in that order.

The Exploration Division is responsible for prospecting, the staking of claims, the surface exploration of claims by diamond drilling, trenching, etc., the underground exploration of claims, aerial surveying, geological mapping, and all the other types of activity which are embraced by the word "exploration". The division has a general manager, who reports to the president and managing director. This officer is assisted by the company's consulting geologist, Dr. B. S. W. Buffam, and by a competent staff of geologists. Prospectors are engaged on a seasonal basis in accordance with the usual practice. The terms of payment and reward are covered in a prospector's agreement which provides, in addition to salary, a reward of \$1,000 for the discovery of a pitchblende occurrence and for the payment of a further bonus of \$20,000 and of royalties up to \$150,000 as, if, and when, there is production from a deposit.

The Mining Division is responsible for the operation of the company's two producing properties at Port Radium, N.W.T., and Beaverlodge, Saskatchewan. Because of the distances involved, these two operations are separate establishments, each with its own manager reporting to the president and managing director. I shall have something to say at a later point of the nature and scope of these two operations. For the present, I shall say simply that they are similar in most respects to other mining operations in remote areas.

The Refining Division is responsible for the operation of the refinery at Port Hope, Ontario. This division also has a manager who reports to the president and managing director. The word "refinery" is something of a misnomer. Actually, the refinery is an extension of the concentrating or milling process, which is normally undertaken at a mine. For example, in most gold mines, the concentrator or mill is able to bring the product to the purity required by the purchaser. In the case of uranium, the large quantity of chemical reagents involved in the final concentration has made it more economic to bring the rough concentrate to the source of reagent supply rather than to bring the reagents to the mine site. This will explain the present location of the company's refinery. The product of the Port Hope refinery is a uranium black oxide. The refinery is also producing radium and a smelter product containing cobalt.

In addition to these operating divisions, the company has two service divisions—the Aviation Division and the Northern Transportation Company Limited, which is a wholly-owned subsidiary.

The Aviation Division is responsible for handling the transportation of personnel, perishables, and emergency freight to the company's various operations north of Edmonton. The division is now operating a DC-3 aircraft and a C-46 aircraft in its transport service, and a Norseman aircraft and a Fairchild aircraft for the Exploration Division. The operation is based at Edmonton where hangar facilities are maintained for maintenance and general overhaul. The company has constructed and maintains airport facilities at Port Radium and at Beaverlodge. Perhaps a few figures may indicate the scope of the air operation. During 1952, 854,000 miles were flown for a total of 4,900 flying hours.

The Northern Transportation Company Limited operates a water transportation service over the entire Mackenzie watershed. Since this company is a subsidiary, I will deal with its history, and its organization and activities in a separate section at the conclusion of my remarks on the parent company.

With this brief comment on Eldorado's organization, I come to a description of its activities, particularly in recent years.

I have mentioned the decision of the government of Canada that Canada would continue the wartime partnership with the United States in the field of atomic energy. What have we done in implementation of this policy in the field of raw materials? More specifically, what have we done about increasing production from existing sources, and what have we done about finding new sources of production?

At the end of the war, the Eldorado mine at Port Radium faced two problems—depleted ore reserves and an inadequate ore dressing process. Both of these conditions were the result of the mining practice followed during the war years when the objective was to obtain as much production as possible in as short a time as possible, regardless of the effect on the mine's postwar fortunes.

A large-scale underground development program was launched in 1947 in the hope that ore reserves could be restored to a normal level, and if possible, increased. I am glad to be able to report that this program proved successful. The ore reserve position at Port Radium is today healthier than it has been at any time since the opening of the mines. The mine has now been developed at

eleven levels to a depth of 1,300 feet. An internal shaft is being sunk from the 1,100-foot level which will permit development in the area northeast of the main shaft at five levels to a depth of 1,925 feet. The nature of the deposit at Port Radium is such that it appears unlikely that it will ever be possible to block out ore reserves beyond a four or five-year period. However, this is of no particular concern, providing it is possible to maintain a four or five-year reserve which has been the case thus far.

In 1946, the Mines Branch of the Department of Mines and Technical Surveys began an intensive research program in an effort to improve mill recoveries at Port Radium. The objective was to improve the existing process or to develop a new process which would increase mill recoveries. The ore dressing process in use prior to the war and during the war involved concentration by gravity or mechanical methods. As indicated above, this method proved inadequate during the post-war years because of the nature of the ore then available for mining. The mines branch was able to develop a leaching process which would permit the recovery of a large part of the uranium in the residues from the gravity concentrator. Fortunately, the residues from the gravity mill had been impounded since the re-opening of the mine in 1942. Last May, a new leaching plant, built at a cost of \$2 million, was brought into operation. This plant will treat both current and stored residues. Its operation, together with the operation of the gravity plant, will increase production at Port Radium by approximately 75 per cent. The average payroll at Port Radium is 250. Its annual operating budget is approximately \$4 million.

Eldorado began to look for new sources of uranium late in 1944, but it was not until 1947 that the exploration program reached major proportions. In that year, a large number of radioactive occurrences were located and staked in the vicinity of Beaverlodge Lake in northwestern Saskatchewan. One of the claims, at Martin Lake, was explored from an adit driven during the latter half of 1948 and the early months of 1949. During this same period, two other groups of claims, the Ace and the Eagle, were explored with surface diamond drilling. On the basis of the results of these diamond drilling programs, it was decided to sink prospect shafts on the Ace and Eagle claims. This work got under way late in 1949. By April of 1951, it was possible to establish a provisional estimate of ore reserves on the Ace property of sufficient size to justify a mining operation of 500 tons per day. It is expected that production from the Ace mine will begin in April of this year. Milling will commence at the rate of 500 tons per day, but the mining plant is designed to handle an ultimate capacity of 2,000 tons per day. At this point I should like to quote certain excerpts from the company's annual report for 1951 which deal with some aspects of the Beaverlodge operation.

"In the annual report of 1950, an outline was presented of the program to be undertaken during 1951. This comprised the sinking of the Ace shaft to the sixth level and the development of both the east and west ore bodies at six levels, the sinking of a five-compartment production shaft on the Fay zone, and the driving of a haulage-way on the sixth level of the Ace mine to connect with the production shaft. In addition, it was anticipated that the development program on the Eagle property would have reached the stage by June 1, 1951, when possible ore reserves could be estimated.

Some statement of the policy underlying this program seems appropriate at this time. Under the best of conditions, the development of mineral deposits is both speculative and costly. The normal risks have been aggravated in the present instance by two factors. First, the great urgency of demand for uranium and second, the inaccessibility of the Beaverlodge property, except by air, for almost eight months of the year. It is in the national interest that every possible effort should be made to speed up and increase the deliveries

of uranium. Therefore, the saving of time has a greater significance in uranium mining than in the mining of other minerals. This situation, difficult enough in itself, has been complicated further by the fact that a four months' navigation season makes it imperative that the planning of a program be completed twelve months in advance of its execution. Otherwise, orders for equipment and supplies cannot be placed in time to ensure delivery. The combination of these two factors—the pressure for production and geographic location—cannot help but increase the risks, and in some cases, the cost, involved in the development of the company's Beaverlodge properties.

In April 1951, the company's consultant, Dr. B. S. W. Buffam, presented to the directors a provisional estimate of ore reserves on the first two levels of the Ace mine. This report showed sufficient reserves to warrant a mining operation of 500 tons per day. At the same time, there was made available the results of a surface diamond drilling program carried out in the winter months of 1950-51 on the Fay zone. This zone is located in the footwall of the St. Louis Fault approximately 4,000 feet southwest of the Ace shaft."

If I may just break off from the brief for a moment. I have maps of this area and so on which I will be glad to produce if it will make the brief more intelligible.

"Subsequently, a surface diamond drilling program located a third zone, the Ura zone, lying in the hanging wall of the St. Louis Fault some 400 feet south of the Fay shaft. The results of these drilling programs were most encouraging, having in mind the location of the zones in relation to the St. Louis Fault. The directors were faced with these alternatives—the choice of a program involving the separate development of the Ace property and the Fay and Ura zones, or the choice of a program combining the two developments. The first choice required the fitting-out of the Ace shaft for production and the erection of a mining plant and concentrator at the Ace mine with a daily capacity of 500 tons and, in addition, the sinking of a shaft to explore and develop the Fay and Ura zones. The second choice involved the sinking of a single shaft at a site which would permit its dual use as a production shaft for the Ace mine and as a base of development for the Fay and Ura zones. In selecting the second alternative, the directors were governed by several considerations. First, the separate programs offered no advantage from the standpoint of early production—a requirement of paramount importance. On the contrary, there was some reason to believe that the adoption of the combined program might guarantee earlier production since it would allow the exclusive use of the present Ace mining plant for the completion of development and mine preparation without interruption which would occur if a new mining plant had to be installed. Second, while the sinking of one production shaft and the erection of a mining plant with a capacity capable of serving three zones, for example 2,000 tons per day, would require a larger immediate expenditure than a program involving the erection of a mining plant for the Ace property only and the sinking of a prospect shaft on the Fay zone, there would be an ultimate saving of substantial proportions since there would be no need to provide duplicate facilities when production from the Fay and Ura zones became available".

I am still quoting from the annual report.

"Reference was made in the 1950 annual report to research on the dressing of ores from the Ace mine. This program was undertaken jointly by the mines branch in Ottawa, an ore dressing group at the company's Port Hope refinery, and a research team at the University of British Columbia. The objective was to permit the choice of a satisfactory ore dressing process not later than October 1, since, unless this deadline could be met, it would be impossible to begin the construction of the mill building and the installation of its equipment during 1952. Following the completion of laboratory tests, it became possible

to undertake pilot plant operations with a minimum of delay because of the availability of suitable facilities in the Ottawa plant of Sherritt Gordon Mines Limited. The company was able to obtain the services of C. S. Parsons as consultant on metallurgy and ore dressing shortly after his retirement as director of the mines branch of the Department of Mines and Technical Surveys. The pilot plant operations in Ottawa were under his general direction. In mid-September, Mr. Parsons, after reviewing the results of the several research programs, recommended the choice of a process employing a carbonate or basic leach. In his report, Mr. Parsons stated that while the chemistry of the process had been proven, the engineering of the flowsheet was incomplete. He suggested that under normal conditions, consideration would be given to further pilot plant work at the Ace mine. However, since this would involve a delay of from twelve to eighteen months in bringing the property into production, it was his recommendation that the design of a concentrator with a daily capacity of 500 tons should be proceeded with immediately. The decision as to capacity was influenced by two factors. First, the ore now available for mining will only support a 500-ton-per-day operation. Second, there is some expectation that improvements may be made in the ore dressing process as a result of the intensive research program which is now being carried out by the mines branch of the Department of Mines and Technical Surveys. These improvements could affect both the chemistry and the engineering of the flowsheet. It seemed unwise, therefore, to provide milling capacity beyond the immediate requirements in view of the possibility that an improved process might be available when the mine tonnage is increased."

That is the end of the quotation from the annual report.

By way of comment on these excerpts from the annual report of 1951, I should like to emphasize that the risk inherent in all exploration programs is increased greatly when time becomes the dominant factor.

The production of uranium from the Ace mine will be approximately 40% greater than the present rate of production at Port Radium. If, as we have reason to hope, the underground development program on the Fay and Ura zones is fruitful, the ultimate production may be two or three times the initial rate of production.

The total investment in the property at the commencement of operations will be \$19 million. This includes the cost of preliminary exploration, diamond drilling, underground development, mine preparation, production buildings and equipment, housing, roads, and an airport. The average payroll is expected to be 400, and the estimated annual operating budget is \$4 million.

The exploration division is carrying out exploratory work of the company's other claims in the Beaverlodge area. This consists of geological mapping and surface diamond drilling. In December last, a large block of claims was staked in the Foster Lake area of Saskatchewan. This ground will also be explored thoroughly during 1953. It is proposed to supplement ground exploration with the use of an airborne detector, a method of prospecting which Eldorado developed in 1950 and 1951.

This recital of the facts of Eldorado's exploration and mining activities would not be complete without some mention of the extraordinary conditions with which the company has to contend. The Port Radium mine is located twenty-three miles south of the Arctic circle, 1,000 miles north of Edmonton by air, and 1,400 miles by water from railhead at Waterways, Alberta. The season of open navigation generally lasts from early July until late in September, or something under three months. The mean temperature for the year is 22° with a mean during the months of November to March of 10° below, and frequent temperatures of 50° below. During these same months, there is an average of six hours of daylight with an average of as little as three hours during November, December, and January. By comparison, the Ace mine at

Beaverlodge might be said to enjoy an almost tropical location. However, this property is also remote by any normal standards. It is some 500 miles north from Edmonton by air and 300 miles by water from railhead at Waterways. The season of navigation lasts from June 1st, until October 1st, or four months. The climate, while somewhat warmer in midsummer, is equally severe in the winter months. I mention these conditions in the hope that I may convey to you some appreciation of the operating problems which have to be faced each day and of the special problems which have had to be faced in expanding existing production and developing new production. We have what might be described as a continual problem in logistics. This daily struggle with the hard facts of geography and climate has been aggravated by the increasing demand for more production. The Beaverlodge development is an excellent case in point. When the Ace ore body was located in April, 1951, a production target of April 1, 1953, was established. This meant that the development of an ore dressing process—there was no known process suitable for the treatment of the Ace ores—the preparation of plans and specifications for the mining plant and concentrator, and the ordering of supplies and equipment, all had to be completed in the eight-month period from May 1, 1951, to December 31, 1951; otherwise, deliveries could not be made during the navigation season of 1952. It meant also that construction had to begin in April of 1952 and in order to maintain the construction schedule that some 2,400 tons of building supplies had to be flown to Beaverlodge before the opening of navigation in 1952. Those of you who have some knowledge of the problems incidental to the establishment of new production capacity will recognize at once the problems involved in maintaining a schedule of this kind.

In my previous comment on the Port Hope refinery, I pointed out that this plant was an extension of the mill or concentrator. The plant was designed to refine the product of the Port Radium operation—a gravity concentrate. It will now refine, as well, the product of the leaching plant at Port Radium—a precipitate. The process consists in the main of a roaster and smelter for the preliminary treatment of gravity concentrates and a chemical circuit for the final extraction of uranium black oxide. The refinery has a payroll of 150 and an average annual operating budget of \$1,200,000. As you have probably learned from your examination of the Chalk river project, uranium for use in a pile or reactor is in the form of a metal. Canada does not produce uranium metal at the present time. That this should be so is simply a matter of economics. The production of raw materials now available in Canada for processing is not great enough to warrant the production of uranium metal. It is a reasonable expectation that at a relatively early point in the now increasing curve of uranium production, metal production will become economically possible in Canada. Against that day, Eldorado has developed a new and improved refining process and is studying the technique of metal production.

Financial Affairs

In commenting on the financial affairs of the company, I should like to emphasize that it is our constant endeavour to maintain a position of self-sufficiency. In other words, we are trying to operate the company in the black and, in addition, to finance our expansion program from revenues. A perusal of the financial records of the company will indicate the measure of our success in this regard. It will be recalled that the government paid \$1.35 a share for the stock of Eldorado at the time of the expropriation in 1944. Since there were 3,905,046 outstanding shares, this represented a total payment of \$5,271,812.10. In 1946, the authorized capital of the company was increased from 60,000 shares to 120,000 shares.

I might mention here, at the time of the change in the charter of the company and at the time of the expropriation, the capital structure was revamped. It had previously been 4 million shares and it was revamped to give it a capital of 60,000 shares and in 1946 the authorized capital was increased from 60,000 shares to 120,000 shares.

Mr. BROOKS: How many shareholders were there?

The WITNESS: I can find that out for you.

The government took down 40,500 shares in addition to its original holding of 40,000 shares and paid over to the company \$3,975,064.72. This total investment by the government of \$9,246,876.82 was reduced in 1950 by \$1 million through the redemption of 10,000 shares of capital stock, and by \$1,057,500 in 1951 through the payment of a dividend. In the period 1946 to 1951 inclusive, the company has had total gross earnings of \$33,801,668, a total net profit of \$7,589,580, and has incurred capital expenditures in the amount of \$5,408,191.

I might point out that those are the figures at the end of 1951.

The value of the company's fixed assets as at December 31, 1951, was \$7,745,861. The estimated value at the end of December 1952, was \$17,188,972.04 less a provision for depreciation in the amount of \$3,942,373. Working capital as at December 31, 1946, was \$2,812,535, and as at December 31, 1951, was \$9,694,838. I regret that I am unable to give you the figures for 1952 as our final audit has not been completed. With the heavy expenditures in 1952 and 1953 incidental to the Beaverlodge development, the company was unable to continue the dividend policy established in 1951. If, as is now anticipated, the Beaverlodge operation can be brought into full-scale production by mid-1953, the company should be in a position to resume the payment of dividends at the end of 1954. This statement is made on the assumption that it will not be necessary to embark on large capital expenditures during that year. Should it be decided to proceed with the establishment of new refining facilities or should underground development programs on new properties be undertaken, the company's anticipated surplus would, in all probability, be required for these projects.

Purchasing Policy

A brief review of the situation in the immediate postwar years is essential to an understanding of the present policy.

It will be recalled that during the war years and in the immediate postwar years, title to uranium in Dominion territories was reserved to the Government of Canada, and in certain of the provinces, was reserved to their governments. This reservation came about in the first instance as a result of a joint decision of the three partners in the wartime atomic energy program, Canada, the United Kingdom, and the United States, that a close control should be maintained of all radioactive minerals. Since there was at the time no statute providing for the control of radioactive materials, this seemed to be the most effective method of handling the situation.

Normally, this reservation of title would have been removed at the end of the war. Certainly those of us who were concerned with the raw materials program were convinced that we could only hope to bring about a substantial increase in uranium production by attracting the prospector and the mining industry. Obviously, this could not be done so long as the reservation of title continued. However, there was a complication. I have already referred to the effort made by the United Nations to establish a satisfactory instrument for the international control of atomic energy. These discussions began in 1946 and lasted during most of 1947. In retrospect, it seems clear that the Soviet and her satellites intended to sabotage this effort from the outset. However, so long as there was any hope of reaching agreement, it seemed desirable that no change should be made in the wartime regulations governing

the control of raw materials. This was especially so since one of the proposals contained in the Baruch plan submitted by the United States delegation was that an international agency should be established which would not only control atomic energy at all of its stages but would also control raw materials in situ. When it became evident that agreement was impossible, it was decided by the Government of Canada that the reservation of title to uranium minerals in Dominion territories should be removed. Those of the provinces which had also reserved title took similar action. This created no difficulty since adequate control of raw materials, and especially the export of raw materials, had been provided through the regulations of the Atomic Energy Control Board which was established on August 31, 1946.

On March 16, 1948, the government established a price schedule for uranium for a period of five years and designated Eldorado as its purchasing agent. Revisions have been made, both in the price and the period of the guarantee. With the thought that it may be helpful, I have had prepared a memorandum setting out the several modifications in purchasing policy which have occurred. With your permission, I shall include this memorandum in my evidence.

"The first announcement concerning the purchase of uranium was made by the Right Hon. C. D. Howe, in the House of Commons on March 16, 1948, as follows:

The government will purchase through Eldorado Mining and Refining Limited, or other designated agency, acceptable uranium-bearing ores and concentrates on the following basis:

1. A minimum uranium content equivalent to 10 per cent by weight of uranium oxide (U_3O_8) in the ores or concentrates will normally be required.

2. Price will be based on the uranium content of the ores or concentrates and will be at the minimum rate of \$2.75 per pound of contained (U_3O_8) F.O.B. rail and will be guaranteed for a period of five years.

3. This price includes all radioactive elements in the ores or concentrates, but consideration will be given to the commercially recoverable value of non-radioactive constituents by adjustment of price or by the re-delivery of the residues containing such constituents.

4. Under special circumstances, consideration may be given to payment of a higher price or to acceptance of ores or concentrates of lower grade.

5. All operations will be carried on subject to the provisions of the Atomic Energy regulations of Canada."

On December 20, 1948, the Right Hon. C. D. Howe announced in the House of Commons that the period of the guaranteed price had been extended to March 31, 1955.

A further amendment to the purchasing policy was announced by W. J. Bennett on April 18, 1950. This was designed to encourage the development of low grade deposits and efficiency in ore dressing by payment of a milling allowance on ore treated. The formula for determining the price to be paid for the U_3O_8 content of the concentrates is based upon four factors:

(1) \$2.75 per pound for the average U_3O_8 content of the ore or mill feed;

(2) A milling allowance of \$7.25 a ton of ore milled;

(3) A maximum price based on a mill head of 0.25 per cent U_3O_8 ;

(4) A minimum extraction of 70 per cent.

Eldorado Mining and Refining (1944) Limited will purchase, f.o.b. rail, acceptable concentrates, which normally will be required to contain a minimum

uranium content equivalent to 10 per cent by weight of uranium oxide (U_3O_8) and will pay for the U_3O_8 content at a price per pound determined in accordance with the following formula:

The price per pound to be paid for the U_3O_8 content of acceptable concentrates containing 10 per cent or more by weight of U_3O_8 shall be the product obtained by multiplying the average number of pounds of U_3O_8 per ton of mill feed by \$2.75 a pound, adding to this a milling allowance of \$7.25 a ton of ore milled, and dividing the sum of the two by 70 per cent of the average number of pounds of U_3O_8 per ton of mill feed.

The maximum price per pound for the U_3O_8 content of acceptable concentrates that will be paid under this arrangement is that based upon the formula applied to an ore with an average grade of 0.25 per cent or 5 pounds per ton.

As the price is based upon the average grade, Eldorado reserves the right to adjust the contract from time to time to bring it into conformity with actual operating results.

The formula is designed to encourage efficiency in ore dressing. Although the minimum extraction of 70 per cent is used in the formula, it will be apparent that if recovery exceeds 70 per cent there will be more pounds of U_3O_8 to be purchased. Hence the value per ton of ore mined and milled will be greater.

Although the price includes all radioactive elements in the concentrates, arrangements will be made for valuing other constituents that can be recovered commercially.

The following examples show how the formula is applied:

(1) Grade of ore, 0.25 per cent, or 5 pounds a ton	
5 x \$2.75.....	\$ 13.75
Milling allowance	7.25
	<hr/>
Value of ore per ton.....	\$ 21.00
Recovery, 70 per cent of 5 pounds=3.5 pounds	
Price to be paid for the U_3O_8 content of concentrates: \$21.00 + 3.5.....	\$ 6.00 a pound
	<hr/>
(2) Grade of ore, 0.5 per cent, or 10 pounds a ton	
10 x \$2.75.....	\$ 27.50
Milling allowance	7.25
	<hr/>
Value of ore per ton.....	\$ 34.75
Recovery 70 per cent of 10 pounds = 7 pounds	
Price to be paid for the U_3O_8 content of concentrates: \$34.75 + 7 =	4.85 a pound
	<hr/>
(3) Grade of ore, 0.75 per cent, or 15 pounds a ton	
15 x \$2.75	\$ 41.25
Milling allowance	7.25
	<hr/>
Value of ore per ton.....	\$ 48.50
Recovery 70 per cent of 15 pounds = 10.5 pounds	
Price to be paid for the U_3O_8 content of concentrates: \$48.50 + 10.5 =	\$ 4.62 a pound
	<hr/>

The Right Honourable C. D. Howe announced in the House of Commons on April 17, 1950, a further extension of the guaranteed price period to March 31, 1958.

On March 6, 1951, Eldorado announced a further revision in the price schedule by which the price paid per pound of U_3O_8 content for mill products produced during the first three years of production, or any part thereof, will be increased by \$1.25 a pound. Thus, for example, the U_3O_8 content of a concentrate produced from an ore with an ore with an average grade of 0.25 per cent or lower will be paid for at the rate of \$7.25 per pound during the first three years of production. In the case of a concentrate produced from ore of 0.5 per cent average grade, the new price will be \$6.20 a pound of U_3O_8 content, for the first three years, and so on.

The period during which these prices are guaranteed was also extended to March 31, 1960.

On May 6, 1952, the Right Honourable C. D. Howe announced in the House of Commons that the period during which these prices are guaranteed would be again extended to March 31, 1962. That is the end of the price memorandum.

I should like to mention several aspects of the current purchasing policy.

First, may I say a word about the reason for Eldorado's selection as the procurement or purchasing agent. The bulk of the uranium being produced in the free world is being used by the United States Atomic Energy Commission for the manufacture of atomic weapons. The selection of Eldorado as the procurement agent was, I believe, influenced by two factors. First, Eldorado had established a pattern of relationship with the buyer which had proved mutually satisfactory. Second, Eldorado was the only company in Canada with facilities for refining uranium to the specifications which the buyer required. So long as uranium is subject to control, that is to say, so long as it cannot be sold in the open market, it seems to me that the use of a single procurement agency is inescapable. Bearing in mind the price fluctuations which affect other base metals, it can be argued that a guaranteed base price is sufficient compensation for any disabilities which are thought to be associated with a single market. A time may come when world conditions will permit a free market for uranium. Whatever advantages this may bring, a guaranteed price is not likely to be one of them.

There has been considerable discussion from time to time as to the adequacy of the prices established in the current price schedule. As a preliminary to my comment on this point, I should like to clear up a common misconception. This is the impression that there is an unlimited demand for uranium at any price. It is difficult to correct this impression with a categorical "Yes" or "No". In either case, the statement must be qualified, as I shall seek to point out. This impression is associated, although rarely in mining circles, with the belief that Canada has some kind of monopoly of uranium supply and is therefore in a position to dictate the world price. What are the facts? At present, the only Canadian export market is the United States Atomic Energy Commission, an agency of the United States government. Canada is one of several existing sources of supply, but by no means the most important. Whether our new finds will change this position, I cannot say. This will depend on the level of production in other countries where important new discoveries have also been made. The conclusion inherent in these facts is, I think obvious. The buyer fixes the price and he does so as nearly as possible on a uniform basis. This means simply that even in the absence of a free market for uranium, the fact that there is one buyer and several sources of supply makes for the establishment of parity in prices.

It will be evident from the memorandum on purchasing policy which I have read to you that some evolution of policy has occurred in Canada. Prior to the establishment of the first price schedule, it was decided to set up an

advisory committee and to seek the advice of this committee as to what the base price should be. On this committee was represented the mining industry, the Canadian Association of Prospectors and Developers, the Department of Mines and Technical Surveys, and Eldorado. During its deliberations, the committee consulted with a similar organization which was acting in an advisory capacity to the United States Atomic Energy Commission. This committee was endeavouring to work out a satisfactory price schedule for production from the United States sources. From the inception of the purchasing policy, an attempt was made to maintain some equality of prices as between the two countries. The differences in the two price schedules are differences of form, rather than of substance. The United States price formula is designed primarily to stimulate production from the carnotite deposits of the Colorado plateau where uranium is usually found in association with vanadium. Vanadium has been mined for many years from numerous small deposits readily accessible by highway. It was and still is the practice of the companies engaged in vanadium production to mine their own ores and also to purchase ores from small operators. These ores are trucked to centrally located treatment plants.

When it was decided to encourage the production of uranium in the Colorado plateau, the price formula was accommodated to these conditions. A price schedule was published, with a sliding scale of prices based on the U_3O_8 content of raw ores. Now from what the Canadian committee knew of radioactive occurrences in Canada, it seemed likely that the best chance of finding economic deposits was in the more remote areas of the Precambrian Shield. The development of such deposits would probably require a large amount of capital and would take considerable time. The only Canadian producer in 1948 provided some measure of what could be expected in the way of costs, but because of its very remote location, could hardly be used as the final gauge of what the Canadian price should be. It seemed to the committee that the pattern of development in Canada might be similar to that of gold mines where properties are sometimes isolated, frequently widely separated, and where each property looks after its own milling. The committee therefore recommended a price policy which would enable the prospector to calculate the value per ton at a relatively early stage in a development program, the price to be based on the uranium content of a mill product or a high grade cobbled ore.

I am frank in saying that when the first base price was established, the committee had very little information as to how realistic it might be in relation to production costs in a new area.

Mr. MURPHY: Mr. Chairman, I was wondering how much more there is of this brief.

The WITNESS: About two pages. I could leave Northern Transportation which is separate.

Mr. MURPHY: When you have finished that.

The WITNESS: Consequently, it was made clear that the first price was a base price and that upward revisions would be considered from time to time. The subsequent revisions in price outlined in the price memorandum, while based in part on what is known of probable production costs in the Beaverlodge area, also reflect the continuing attempt to maintain some parity of price with the United States. There have also been several revisions of price in the United States. At the present time, the price schedule in the two countries, while differing in form, give approximately the same net return.

It will be seen that Eldorado has a dual position in the raw materials field, being both a producer and a buyer. This role is analogous in some respects to that of the large base metal companies which mine their own ores and also buy ores for smelting.

We have thought that as the procurement agency, we should do everything possible to encourage the development of promising deposits. Such assistance can be provided most effectively at the technical level. Consequently, it is our practice to make available to reputable persons in the mining industry information on exploration, mining, assaying, and milling techniques.

I think it will be evident from my remarks, and those of Dr. Mackenzie, that the current Canadian program in atomic energy has two distinct parts—the production of raw materials that is, exploration, mining, milling and refining—and the operation of the Chalk River reactor with the double objective of research and production. The first of these activities is the responsibility of Eldorado; the second, the responsibility of Atomic Energy of Canada Limited. While the two programs might appear, at first glance, to have no immediate relationship, on closer scrutiny, it will be clear that they are interdependent. The prime objective of the raw materials program is to increase the supply of uranium for atomic weapons. We may regret that this is so, but at the same time we must be mindful of the fact that the atomic bomb is the most potent means of safeguarding the security of this continent and whatever that may involve in the way of military action elsewhere. I think we may take some consolation from the knowledge that our efforts to increase the supply of uranium for the weapon program, admittedly a short-term objective, will also provide us with a knowledge of our uranium potential which we might not otherwise obtain. The prime objective of the program at Chalk River is to maintain and improve our technology in reactor design and operation in order that we will be able to take full advantage of our uranium resources when the civilian application of atomic energy becomes possible. There is no conflict between these objectives. On the contrary, the attainment of the first is essential to the attainment of the second. If we are to hold the fine position we have gained in atomic energy, we must have both an ample supply of its raw material and the skills so necessary for its application. The current programs of Eldorado and Atomic Energy of Canada Limited reflect this identity of aim.

That is the end gentlemen, of my brief on the Eldorado. The other is the Northern Transportation Company Limited.

Mr. GREEN: Is it very long?

Mr. McCUSKER: I think we should have it.

The WITNESS: I do not think it will take very long.

The CHAIRMAN: It is eight or nine pages. There were 39 pages of the main brief.

The WITNESS: It will take about 15 minutes.

NORTHERN TRANSPORTATION COMPANY LIMITED

History

You are all familiar with that fascinating story of Alexander Mackenzie's journey to the Arctic in 1789. You may not know that water transportation on the Mackenzie system has continued almost without interruption since that year. Until discovering of uranium at Great Bear Lake and the discovery of gold at Yellowknife, first the York boats and then the wood-burning paddle-wheelers which plied this immense waterways served the missions and the fur-trading posts. Commercial transportation as such began in the early thirties. In 1935 the Northern Transportation Company, now the principal common carrier on the route, received its charter.

Organization and Activities

The Northern Transportation Company has its head office in Edmonton with agencies at Railhead, Waterways, Alberta Bushell, the new port of entry for the Beaverlodge area in Saskatchewan; and Fort Smith, Yellowknife, and Bear River in the northwest territories. The original fleet of the company consisted of several wooden tugs and barges acquired at a cost of \$140,000. Today the company's fleet consists of twenty diesel-powered tugs and sixty-three barges, which, together with buildings and equipment, represent a total investment of five and a half million dollars. The company handles approximately 80 per cent of all water-borne freight moving over the Mackenzie system. Of this, approximately 50 per cent is for Eldorado and 50 per cent for other shippers. All water carriers on the Mackenzie system operate under the jurisdiction of the Board of Transport Commissioners. This means that the carrier must obtain an operating licence from the board and must file tariffs with the board. The board has complete jurisdiction over all rates. This is in contrast to its control of rates in the lake and coastal services where bulk cargo is exempt from the board's jurisdiction. The arrangement has both advantages and disadvantages. The obvious advantage, both from the standpoint of the shipper and the carrier, is the availability of a court where rate grievances can be argued and settled. The disadvantage lies in the difficulty of accommodating the requirements and procedures of the Board of Transport Commissioners to rather unique operating conditions. I should like to speak for a moment of these conditions and I will discuss them under the following general headings: Climate, water levels, portages, and the volume of freight.

A glance at the map does not necessarily give one a real grasp of the extent of the area served by the Northern Transportation Company. From the base of operations at Railhead Waterways, Alberta, to Kittigazuit at the mouth of the Mackenzie is approximately 1,700 miles. If there are included the off-route services to Bushell on Lake Athabasca to Yellowknife on Great Slave Lake, and to Port Radium on Great Bear Lake, the total distance operated by the company's fleet is approximately 2,400 miles. As these routes lie between the 56th and the 70th latitudes, climate plays an important part in the operations. As a general rule, shipping out of waterways does not begin until the middle of May. Lake Athabasca cannot be crossed before the first of June, Great Slave Lake before the middle of June, and Great Bear Lake before the middle of July. Similarly, at the end of the season, ice conditions usually force the closing of navigation on Great Bear Lake and the lower Mackenzie late in September and navigation on the Slave and Athabasca Rivers ceases somewhere between the first and the 15th of October. In other words, the longest period of navigation, that is, on the southern part of the route, extends for a period of from four to five months, while the shortest period—on Great Bear Lake—extends for a period of two months.

Water levels are a serious problem. Flood conditions frequently prevail early in the season, due to the run-off from the mountains, but unless the rainfall is heavy in midsummer, and this is rare, low water on the rivers, especially the Athabasca, invariably occurs in the late months of the navigation season. This has several effects—all of them bad. First, floating equipment must be designed to meet two very different and conflicting requirements—shallow draft for the rivers—in the case of the Athabasca 2 feet 6 inches—and deep draft for the large lakes. The compromise, as is usually the case with compromises, results in a design which is not entirely satisfactory for either condition. Second, the inevitable low water which prevails in August and September reduces the carrying capacity of the barges sometimes by as much as 65 per cent. Both of these factors, design and partial loading, increase the cost of operation. Finally, the margin of water in the Athabasca is such

that an abnormally dry season can shorten the period of navigation and sometimes with unfortunate results. Such a thing occurred in the season of 1951. As I mentioned a moment ago, April 1953 was fixed as the production date for the Beaverlodge operation. This made it necessary that site preparations and foundations for the mining plant and the concentrator be underway not later than March of 1952. While we did not have detailed plans of either plant until late in 1951, sufficient design data were available by late August to permit us to order the bulk of the building supplies, principally cement and form lumber. Normally, all of these supplies would have been delivered during the period between September 1st and October 15th. A very dry season, plus an early freeze-up forced the close of navigation on the first of October with the result that a large part of the building supplies could not be delivered.

We commonly think of portages in connection with canoe trips and even then they have an association which is not entirely pleasant. The same may be said of the two portages on the Mackenzie river system. They add greatly to the cost and to the time which is involved in the movement of freight. The first portage bypasses a series of three rapids on the Slave river extending for sixteen miles between Fort Fitzgerald and Fort Smith. All northbound freight must be unloaded at Fort Fitzgerald, transported by truck across the portage, and reloaded at Bellrock, the terminal of the Northern Transportation Company, some eight miles north of Fort Smith. The second portage is on the Bear river which empties out of Great Bear Lake into the Mackenzie river. This portage bypasses a series of rapids which extend for approximately ten miles. Again, it is necessary to unload and truck around the rapids all incoming and outgoing freight. Not so long ago the handling of freight at these points of trans-shipment was done by hand. It was estimated that an article of freight received nineteen handlings from the time it left the box car at Waterways until it reached the warehouse at Port Radium. Since local labour was not available, the stevedoring crews had to be flown in and housed and fed. Beginning in 1949, the company undertook a program of mechanization employing, in the main, the pallet-board technique. A ton of freight is loaded on a board which is so designed that it can be lifted and moved by a forklift. This method of freight handling is in use throughout the entire system. An article of freight is now handled manually only twice—once when it is placed on the pallet-board at Waterways and again when it is taken off the pallet-board at its destination. The resulting saving in cost will be obvious. However, the use of the pallet-board method is at best a very partial solution of the portage problem. So long as the need for trans-shipment exists, some equipment and crews must be maintained at both portages. Those solutions which would eliminate the need for trans-shipment, for example, a canal, involve very large capital expenditures. The cost of amortizing such expenditures would have to be charged into the freight rate. On the basis of the present level of tonnage this cost of amortization when added to the rate would more than offset the savings in operating cost. In other words, the volume of freight does not now warrant expenditures of this kind. The portages, because of their location, do not affect the movement of freight to the new uranium field at the east end of Lake Athabasca. Because of this, it is possible to make relatively quick deliveries and at a very reasonable rate. The Yellowknife area is affected by the Fitzgerald-Smith portage on the Slave river, and Port Radium is affected both by this portage and by the Bear river portage. The fact that a minimum period of five weeks is required to complete a shipment by water to Port Radium as against two or three days for shipment to Beaverlodge, is due in part to the Fitzgerald-Smith portage and the Bear river portage.

Volume is basic to the operation of any transportation system. Moreover, the successful planning of a transportation operation depends on the regularity

of the flow of freight and the extent to which full utilization of equipment can be obtained. Unfortunately, there is no stability with respect to any of these three factors in water transportation on the Mackenzie system. First, a word about volume. The gross tonnage carried in the ten-year period, 1942 to 1952 inclusive, was 383,475 tons for an average of 34,806 tons per year. The tonnage carried during 1952 was approximately 69,500 tons, the highest in the history of the company. When one considers the distances involved and the amount of equipment required, these are not large figures. For example, one vessel operating on the Great Lakes can handle in the neighbourhood of 225,000 tons in a single navigation season. To make matters worse, there is no consistency of volume from year to year. The following are tonnage figures for the years 1944 to 1952 inclusive: 1944, 28,739; 1945, 14,252; 1946, 27,055; 1947, 35,401; 1948, 49,473; 1949, 38,482; 1950, 42,593; 1951, 53,360; 1952, 69,500.

What is probably more serious, the movement of freight is largely one-way. Over the period, 1942 to 1952, inclusive, the ratio has been about 9 to 1, that is, one ton of freight has been brought out for every 9 tons moved in. In the season just past, the ratio was even more disproportionate, 22 to 1, because of the very heavy movement to the Beaverlodge area. Both the quantity of freight moved and the direction in which it is moved make for a very low load factor. The average for the period, 1942 to 1952, was 45 per cent. One may ask why the company does not tie up equipment with such a low load factor. Unquestionably this would reduce operating costs. On the other hand, it would impair frequency of service. In an operating season of such short duration, frequency of service is imperative. As it is, the company is often hard-pressed to complete deliveries in a single season.

The CHAIRMAN: Gentlemen, that is the end of the brief. Is it your wish that we adjourn now, or shall we start the examination?

Mr. MURPHY: When do we propose to meet again?

The CHAIRMAN: I would suggest Monday forenoon.

The committee adjourned.

